GUADALUPE RIVER FLOOD CONTROL PROJECT
(CORPS) I-880 to I-280
CONTRACT SOILS INVESTIGATION

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GUADALUPE RIVER FLOOD CONTROL PROJECT (CORPS)
I-880 TO I-280
CONTRACT I SOILS INVESTIGATION

Preapred For

Santa Clara Valley Water District

Prepared By

David B. Kelley
Consulting Plant and Soil Scientist

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Introduction and Tasks

This report was generated following an examination of soils of the Guadalupe River Flood Control Project. The project, a cooperative effort of the U.S. Army Corps of Engineers and the Santa Clara Valley Water District, incorporates mitigation for riparian habitat impacts into a floodway enlargement for the Guadalupe River just north of the downtown area of the City of San Jose. Santa Clara Valley Water District will assume maintenance of the riparian plantings after project completion and vegetation establishment. This work was performed at their request.

Activities on the site, occupying about 4.6 acres in Contract I of the work, have included the excavation of up to 15 feet of overlying soils to create a new surface which will be planted to woody riparian species to create riparian habitat along the Guadalupe River between Hedding Street and Interstate 880. Later phases of the project will involve similar activities in upstream reaches of the river.

This soils investigation was conducted to identify constraints to establishment and regeneration of planted trees in the exposed soils, help provide interpretations of soil moisture and groundwater status over the 4.6 acres, and evaluate topsoil fills brought into the excavated area following overburden removal. These examinations were designed to help determine what soil remedial measures, if any, might be recommended to help assure the success of revegetation efforts and the establishment of a riparian community.

Investigation: Techniques and Objectives

The soils of Santa Clara County were mapped in 1940-42 by the University of California Agricultural Experiment Station (Weir and Storie, 1947). Another mapping effort was undertaken by the Santa Clara County Planning Department in conjunction with the U. S. D. A. Soil Conservation Service (SCS) in 1963 for soils of western Santa Clara County (unpublished), and a later mapping effort was undertaken for the soils of Eastern Santa Clara County by the SCS and the University of California Agricultural Experiment Station (Lindsey, 1974). The information in these documents was useful in analyzing soils exposed by project excavation.

The investigation was conducted to identify root and water penetration constraints in the profile below the newly-cut surface. The primary features examined were structural features of the profiles, including textural changes, horizon boundaries, and water-

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holding capacities of the strata exposed. A preliminary examination was conducted with a hand auger (on 25 April 1994) and a more intensive examination was conducted in backhoe pits on 2 and 3 May. Several features were noted and logged, some photographs and soil samples were taken, and several pits were excavated to water-bearing strata.

The site is highly disturbed. As many as 15 feet of overburden materials have been removed to create a new surface for planting to riparian vegetation. The exposed surface has been treated, in these descriptions, as a soil. Backhoe pits were opened to expose profiles for description. Some excavations were as deep as 16'; all were at least 4 - 5' deep. Preliminary hand-auger examinations were made to identify trench sites, and the secondary channel which bisects the site longitudinally was traversed to observe profiles exposed in its construction.

Results

The area examined has a complex depositional history. The soils of the site were formed in alluvial materials deposited by streams debauching from hills south of the site and from bay or backwater sediments associated with the southern arm of San Francisco Bay and its associated estuary. The materials exposed in the excavation include long-buried strata showing little soil development and other strata (buried paleosols) with significant pedogenesis.

The excavated site lies along the Guadalupe River which runs from south to north in this reach. The site is generally level and is bisected by an engineered secondary channel running parallel to the river. The riverside portion (lying between the river and the secondary channel) is almost barren except for a short-statured gallery of mixed riparian forest trees and shrubs along the riverbank. The parkside portion (lying between the secondary channel and a newly-constructed walkway running the length of the site parallel to the secondary channel) is divided by a concrete storm drain outfall and associated tributary channel which enters the secondary channel above its confluence with the river. The flats of the parkside portion have an intermittent cover of annual grasses and broadleaved weeds.

While it is beyond the scope of this report to fully describe the exposed profiles of the soils examined, the following typical profile descriptions reflect the results of the detailed site survey. These typical profiles are generalized descriptions derived from the specific descriptions shown in Appendix I.

Profile Descriptions

Typical profile to 13'--Riverside (southern end)

Depth in inches	Description
0 - 8	compacted topsoil fill, mostly clay materials
8 - 28	miscellaneous fill materials
28 - 34	fine sandy clay or fine sand
34 - 48	dark gray clay, highly mottled
48 - 132	heavy black clay with black sand layers
132 - depth	water-bearing gravels in sand matrix

Typical profile to 13'--Parkside (southern end)

0 - 12	compacted topsoil fill, mostly clay materials
12 - 14	fine sandy clay or fine sand
14 - 60	dark gray clay, highly mottled
60 - 144	heavy black clay with sand layers
144 - depth	water-bearing gravels in sand matrix

Typical profile to 13'--Parkside (northern end, below storm drain)

0 - 12	compacted topsoil fill, mostly clay materials
12 - 28	fine sand or fine sandy clay
28 - 60	dark gray clay, highly mottled
60 -154	heavy black clay with sand layers
154 -depth	water-bearing gravels in sand matrix

Groundwater

The depth to water-bearing gravels varies from the normal 12-13' (over most of the site) to less than 11' at the north end of the riverside section and to over 16' at the northern end of the parkside section. Excavations of pits into water-bearing gravels below the thick, heavy black clay layer allowed water from the underlying gravelly horizons to move to within 3' to 5' of the surface in several of the pits.

Water in root zone

- Some water accumulated in bottom of 5' pits overnight
- Probably due to lateral movement of water through clays or sands
- Probably not due to capillary rise
- May be considered limited available water for roots to <54"
- Water availability to plants in clay soils is limited by slow movement of water through soils and further limited by poor root penetrability

Water in gravel horizons

- Most of site has water confined to gravels below 12'
- Water at this depth is confined by a thick (>5') horizon of black clays and sands
- When the heavy black clay horizon is breached, water rises to within 3' to 5' of surface
- Northernmost pit on site had no gravels or water within 16' of surface (near large cottonwoods along river)

Our recent investigations found no evidence of high groundwater under present conditions. In the test pits which were 4 to 5 feet deep, no groundwater was encountered, nor were characteristics of recent groundwater transgressions noted. It is unlikely that the water table will be found near the surface of the site because of local and regional changes that have taken place over the past 60 - 100 years. In several of the pits, excavations reached 11 to 13 feet before encountering water-laden gravels, overlain and confined by a thick (>5') layer of black clay. In one case, groundwater was not encountered within 16' of the surface (extent of the backhoe's reach). The depth to groundwater probably does not reflect historic groundwater levels; our investigations suggest that, historically, a perched water table occurred above the constraining clay layers noted, but changes in regional water use patterns have modified those conditions.

Implementation of intensive irrigation practices could lead to perched water tables, especially on some of the more restrictive soils of the site. Careful management practices and water conservation efforts can prevent associated problems.

Rooting Profiles

- Most of profiles exposed on site were root-free
- Where roots were found (especially near the remaining trees along river), they were generally confined to the sandy clays and sand layers above the dark gray clays below 24"
- In some cases, more vigorous roots from the mature trees had penetrated the clay horizon but had not proliferated
- Dark clay layers exhibited traces and remains of roots from previous landscapes (probably marsh soils)
- Sandy horizons and, to some degree, fill materials near the river appear to offer the best opportunity for rooting

Nominal Depth to Constraining Horizons

Riverside soils, along top of existing riverbank to edge of secondary channel:

- Extensive filled areas with some roots from remaining trees
- Depth to dark clays varies from >48" at north end to approximately 19" at south end
- Topsoil fill along the riverside is a 5" to 11" thick cap of highly compacted, clayey materials with bricks, concrete, rocks, metal, and other materials

Parkside soils, between lower river walk and secondary channel:

- Disturbed areas with extensive compacted backfill around storm drain outfall emplacement and on inclined surfaces near lower river walk
- Depth to dark clays varies from >48" near outfall to <18" near south end
- Reach north of storm drain outfall has sandy materials to >38" near outfall to <26" near northern end, under cottonwoods
- Topsoil fill ranges from 5" to 20", overlying a sandy layer 2"-26" thick

Compaction

- All surface soils of the site are compacted, probably by vehicular traffic during backfilling and subsequent activities
- Surface of excavation cut, the horizon immediately below the topsoil fill cap, is compacted in the upper 8" of the horizon over most of the site

Topsoil Quality

- Topsoil fill materials are very clayey and highly compacted
- Roots of plants now growing on surface of this backfill are restricted by compaction plating
- Backfill cap has abrupt boundary with excavation surface, usually with textural change (clay to fine sand)
- Water penetrating topsoil fill perches on excavation cut surface and moves laterally (leading to piping and sapping of soil materials along banks of secondary channel)

More detailed descriptions of the exposed profiles can be found in Appendix I of this report.

Recommendations

This site has some very difficult soils for plant growth. Heavy clay layers near the surface will impede root growth and water penetration. Where boundaries are abrupt, especially where horizons differ in texture, penetrability is further reduced by those horizon boundaries. The topsoil fill materials are clayey and compacted and in some cases are not as suitable for plant growth as the underlying horizons. In Appendix I, following each pit description, a one-line recommendation has been noted. In each case, the recommendation is a site-specific (pit-specific) recommendation. Recommendations for cross-ripping to a certain depth should be interpreted to mean that the site should be ripped with ripping shanks or subsoil tools to the depth indicated or deeper, at least twice (at right angles). In every case, the surface should be prepared for planting by disking or harrowing following the ripping operation, and steps should be taken to prevent re-compaction of the root zone soils during horticultural operations (planting, irrigation, maintenance, etc.). If re-compaction of surface soils occurs during implementation of the planting plan, remediation of the compacted zones should be undertaken. In every case, ripping and disking should avoid the roots of existing trees and should not take place within the dripline of those trees.

These recommendations should be considered minimum site preparation efforts. If cross-ripping to depths greater than those recommended is feasible, then that should be undertaken. Further remediation efforts may be required (including fertilizer amendments, mulching, weed control, individually-adjusted water regimens, and other remedial horticultural practices). These recommendations address only the issues of drainage and soil structure within the root zone of the proposed plantings.

The following management option outlines are presented as suggestions for maximizing site capabilities given the constraints mentioned.

Surface/Sub-Surface Manipulation

- The site should be cross-ripped to a depth of at least 30".
- The surface should be disked following cross-ripping.

The major constraining factor open to management on this site appears to be the presence of sub-surface horizons where abrupt boundaries between soil horizons of dissimilar textures prevent water penetration and will prevent root penetration by roots of tree species slated for planting.

The imported topsoil backfill (from 2 to 14" deep on the excavated portion of the site) is highly compacted across the site, especially in the haul road areas. Some steps should be taken to break up compaction plates in the topsoil fill. Where this topsoil fill overlies layers of fine sand or fine sandy clays, the boundary between the horizons should be disrupted and diffused. In most areas, the first sub-surface horizon is also compacted to a depth of 14-18".

A natural feature of the site is the presence of a dark gray clay horizon, in some places coming to within 15" of the surface. In the portions of the site where the best chances of planting success occur (where a sandy clay or sand horizon comes to within the upper 24" of the profile), the boundary between the sandy horizon and the clay horizon should be broken up (scarified) in order to disrupt the smooth, abrupt boundary and provide a better chance of rooting success for introduced plants.

If this boundary disruption is accomplished by ripping, depth of ripping should be 30" or greater to assure complete scarification. The site should be cross-ripped to this depth, then disked to break up surface clods and allow manipulation of the surface soils for tree planting or irrigation trenches.

Additional Remediation Measures

In addition to the cross-ripping and disking suggested above, the following techniques might be useful on a case-by-case basis.

Extensive deep trenching (to >5', or to gravel horizons)
- cutting and filling with backhoe to mix horizons, disrupt boundaries, and improve root penetration to greater depths
- particularly useful if rows of trees are to be planted

Augering holes for tree planting
- shallow auger holes not recommended for individual tree wells (would create waterlogged root zones and would not improve chances for regeneration of planted trees) unless sides and bottoms of holes are well-scarified
- sandy soils will not require as much scarification of auger-hole sides as clay and fill soils
- if holes are augered, side-scarification should be accomplished by hand (with three-tined potato rake or other suitable tool)

Revise planting plan to fit site
- some of selected tree species will grow better in sandy substrates, some will survive in clayey substrates
- decision on planting plan should be made following soil remediation efforts

Summary

This site should be able to support the riparian community proposed for implementation and can, with time and good management practices, develop into a reasonable riparian forest. Some remediation of the soil profiles within the rooting zones of the proposed plant community should be undertaken before planting. In this site investigation, soil profiles were examined to determine suitablity for root- and water-penetration and their capability for long-term support and regeneration of the proposed riparian community. Recommendations contained in this report are based on a structural examination of the site's soil and water resources.

- This is a difficult revegetation site. The soils have a high clay content, have been compacted, and are highly stratified. These qualities make it difficult for roots to penetrate to appropriate depths, difficult for gas exchange to occur, especially where perched water tables form, and difficult for water penetration.

- Where a sandy or sandy clay horizon lies within the rooting zone (within 36" of the surface), some effort to disrupt abrupt, smooth boundaries between horizons should be undertaken. Where the rooting zone is primarily clay or clayey materials, boundary disruption (by cross-ripping) appears to be essential.

- Tree planting holes augered into clay horizons are not recommended. If augering is used, hole sides should be completely scarified, especially in the clay soils of the site.

- Planting efforts should include attempts to disrupt (scarify) all smooth boundaries within potential root zone of trees (including sides and bottoms of planting holes).

- Steps should be taken to prevent re-compaction of the root zone soils during horticultural operations (planting, irrigation, maintenance, etc.). If re-compaction of surface soils occurs during implementation of the planting plan, remediation of the compacted zones (all haul roads, access tracks, and maintenance pathways or roads) should be undertaken. Compaction from vehicular or foot traffic should be minimized and a traffic-routing plan should be developed and followed to allow suitable remediation of compacted routes.

- Groundwater does not occur close enough to the soil surface to be immediately available to newly planted trees. Some species of trees will be suitable for portions of the site; some will not make it.

- Other unexamined constraints may be factors in the long-term success of an established community--salty soils or water supplies, pH problems, toxics, or other unidentified problems.

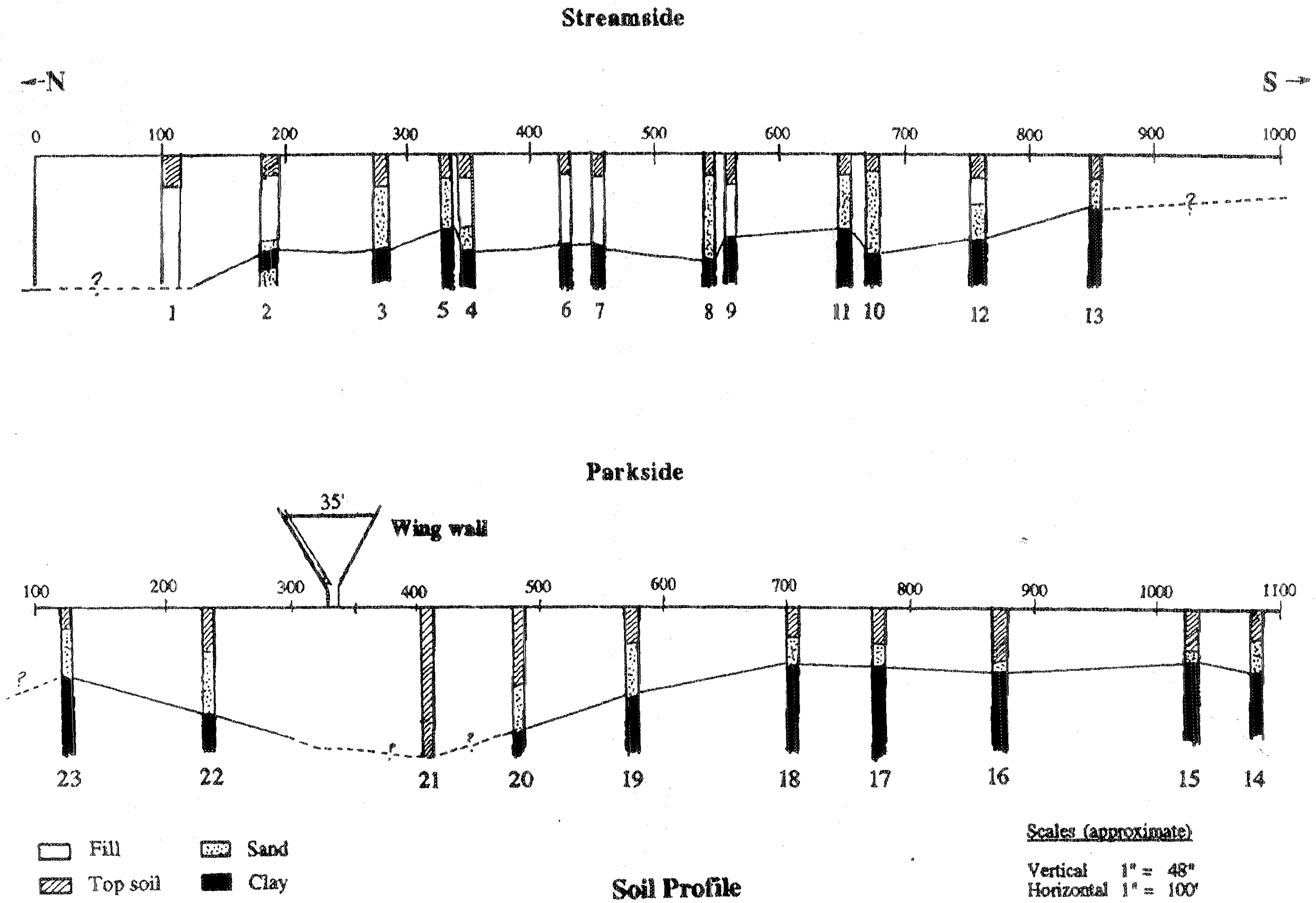
Maximizing the site's potential to support a riparian forest in perpetuity involves the suggested remediation measures, careful handling of plants during planting efforts, and detailed monitoring of plant response to site conditions. Irrigation regimes should be determined on a plant-by-plant basis, since water and root penetration capabilities vary across the site.

Field notes, profile descriptions, and pit-specific remediation recommendations for each of the 23 backhoe pits opened on the site are appended (Appendix I).

References

Lindsey, W. C. 1974. Soil Survey of the Eastern Santa Clara Area, California. U. S. Department of Agriculture Soil Conservation Service, Washington, D. C.

Weir, W. W., and R. E. Storie. 1947. Soils of Santa Clara County, California. University of California Agricultural Experiment Station, Berkeley.



Soil Profile

Lower Guadalupe Flood Control Project

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Appendix I

LOWER GUADALUPE SOIL INVESTIGATION

PIT DESCRIPTIONS/FIELD NOTES/RECOMMENDATIONS

Guadalupe Flood Control Project (Corps)
Interstate 880 - Hedding Street
San Jose, California
Contract 1 Mitigation Site

The soils in Santa Clara County were mapped in 1947 by the University of California Experiment Station (Weir and Storie, 1947), and the soils in Western Santa Clara County were mapped again in 1963 by the Santa Clara County Planning Department in conjunction with the U.S.D.A. Soil Conservation Service (unpublished). Another mapping effort, confined to the eastern portion of the county, was undertaken by the USDA Soil Conservation Service and the University of California Agricultural Experiment Station and published in 1974 (Lindsey, 1974). On 2 and 3 May 1994 David B. Kelley and Terry A. Neudorf conducted an investigation of potential soil constraints of the exposed soils of the site. These notes are an appendix to a report prepared on the site constraints and include pit descriptions and some of the results of field investigations.

The project involves an excavation of an alluvial stream terrace of the Guadalupe River. The soils excavated were formed on stream-deposit alluvia derived from sedimentary rocks and on bay and backwater muds. The mapped soil series are described below (excerpts taken from the 1947, 1963, and 1974 surveys were consolidated to develop these descriptions). Fieldwork correlated with some of the findings of previous soil surveys and no soil unit boundary changes are recommended. The soil descriptions capsulized below are of soils which probably overlay the site prior to excavation for the described project. These descriptions are consolidations derived from the referenced soil surveys. They may not be directly related to those soils investigated in this effort, but the descriptions may be useful for orientation to the site using other soil maps. Included here are some recommendations and other information already included in the report to which this is appended.

Campbell Series

Campbell silty clay loam

0 - 40"	Dark gray silty clay loam, pH ranges from 7.5 - 8.0
40 - 68"	Light olive-brown silty clay loam, pH 8.0

The surface horizon color is commonly dark gray but in places is dark grayish brown. The subsoil has common segregated soft iron masses (mottles). The texture is dominantly silty clay loam, but in places is stratified silty clay. Secondary lime accumulations lie at an average depth of 30 inches.

Campbell silty clay loam, clay subsoil

0 - 36"	Dark gray silty clay loam, pH ranges from 7.5 - 8.0
36 - 60"	Dark gray clay, pH 8.0

The major difference between Campbell silty clay loam and the clay subsoil variant is the presence of the dark gray clay layer which appears at 36 to 54 inches. This clay horizon restricts water movement and may restrict root penetration.

Mocho Series

Mocho silty clay loam

0 - 12"	Grayish-brown silty clay loam, pH 8.0
12 - 68"	Light grayish-brown silty clay loam stratified with grayish brown silt, pH 8.0

The surface texture is predominantly silty clay loam. The subsoil is stratified light silty clay loam and heavy silty clay loam. Finely disseminated lime may be found throughout the profile.

Sunnyvale Series

Sunnyvale silty clay

0 - 14"	Dark gray silty clay; pH 8.0
14 - 34"	Light gray silty clay; pH 8.0
34 - 42"	Gray silty clay, many distinct soft iron masses, pH 8.0
42 - 60"	Light gray silty clay, many distinct soft iron masses pH 8.0

Methods and Results of the Field Investigation

The site is highly disturbed. As many as 15 feet of overburden materials have been removed to create a new surface for planting to riparian vegetation. The exposed surface has been treated, in these descriptions, as a soil. Backhoe pits were opened to expose profiles for description. Some excavations were as deep as 16'; all were at least 4 - 5' deep. Preliminary hand-auger examinations were made to identify trench sites, and the secondary channel which bisects the site longitudinally was traversed to observe profiles exposed in its construction.

Recommendations. Following each pit description, a one-line recommendation has been noted. In each case, the recommendation was a site-specific (pit-specific) recommendation. Recommendations for cross-ripping to a certain depth should be interpreted to mean that the site should be ripped with ripping shanks or subsoil tools to the depth indicated or deeper, at least twice (at right angles). In every case, the surface should be prepared for planting by disking or harrowing following the ripping operation, and steps should be taken to prevent re-compaction of the root zone soils during horticultural operations (planting, irrigation, maintenance, etc.). If re-compaction of surface soils occurs during implementation of the planting plan or subsequent maintenance and watering operations, remediation of the compacted zones (haul roads, etc.) should be undertaken. In every case, ripping and disking should avoid the roots of existing trees and should not take place within the dripline of those trees.

These recommendations should be considered minimum site preparation efforts. If cross-ripping to depths greater than those recommended is feasible, then that should be undertaken. Further remediation efforts may be required (including fertilizer amendments, mulching, weed control, individually-adjusted water regimens, and other remedial horticultural practices). These recommendations address only the issues of drainage and soil structure.

PIT DESCRIPTIONS

Dates of Investigations: 2-3 May 1994
Constraints Descriptions and Field Notes by: David B. Kelley and Terry A. Neudorf

Pit 1: Streamside, North end, 22' east of secondary channel, 84' N of Pit 2, 10' N of north wing of storm drain outfall concrete wall

0 - 7"	compacted topsoil backfill,
7 - 10"	fill materials (clay, gravels, miscellaneous), common fine to coarse roots
10-48"	miscellaneous fill, including roots, clay gravels, large concrete chunks

Recommend: Cross-rip to 24", disk or harrow to break up clods

Pit 2: Streamside, 18' E. of secondary channel, 86' N of Pit 3, 84' S of Pit 1, opposite high voltage tower

0 - 7"	compacted topsoil fill
7 - 32"	miscellaneous fill, mostly clay with rocks and concrete
32 - 36"	fine sand and fine sandy clay, mottled
36 - 42"	dark gray clay with many soft iron masses and root pore linings
42 - 48"	find sand

Recommend: Cross-rip to 32"

Pit 3: Streamside, 27' W of TOB (top of bank), 51' N of Pit 5

0 - 10"	topsoil fill, few fine to coarse roots
10 - 24"	moderately compacted, fine sand, color 10YR 4/2, diffuse boundary
24 -34"	fine sandy clay, highly mottled, matrix 10YR 5/2, bright orange mottles 7.5YR 5/8, abrupt boundary, few coarse roots
34 - 48"	light gray clay, 10YR 4/3, no roots

Recommend: Cross-rip to 28" or deeper

Pit 4: Streamside, 11' W of TOB, 90' N of Pit 6

0 - 7"	compacted topsoil fill,
7 - 25"	miscellaneous fill soils with many roots, fine sandy clay, diffuse boundary
25 - 35"	fine sandy clay, highly mottled, some pure sand lenses, miscellaneous man-made materials (e.g. cables), common coarse roots, matrix 10YR 5/2, mottles 10YR 5/8, abrupt boundary
35" - 48"	dark gray clay, 10YR 3/1

Recommend: Cross-rip to 36"

Pit 5: Streamside, 10' E of secondary channel, 110' N of Pit 6
photo 11 shows black organic layer

0 - 11"	compacted topsoil fill, abrupt boundary
11 - 27"	mixed sand and sandy clay, few fine roots, abrupt boundary
27 - 28"	dark gray clay, black organic layer, diffuse boundary
28 - 48"	dark gray clay

Recommend: Cross-rip to 32"

Pit 6: Streamside, 15 ' W of TOB, beside #1 density test site, 31' N of Pit 7

0 - 6"	compact topsoil fill, abrupt boundary
6" - 31"	miscellaneous fill material, dark clay matrix, common coarse roots
31 - 33"	find sandy clay
33' - 48"	dark gray clay

Recommend: Cross-rip to 30"

Pit 7: Streamside, 9' E of secondary channel, 78' N of Pit 9

0 - 9"	compacted fill
9 - 32"	miscellaneous fill with large concrete chunks, somewhat compacted, some sand pockets, non-uniform, abrupt boundary
32 - 48"	dark gray clay

Recommend: Cross-rip to 36"

Pit 8: Streamside, 1' west of TOB, 46' East of Pit 9, 105' N of Pit 11
near base of box elder, black walnut, willows, photo 14 roots

0 - 7"	topsoil fill material, dark brown
7 - 38"	fine sandy clay with many roots
38 - 48"	dark gray clay, few coarse roots

Recommend: Cross-rip to 40", stay outside dripline of trees

Pit 9: Streamside, 14' E of ditch, 100' N of Pits 10 and 11, in haul road

0 - 11"	clay fill materials, highly compacted
11 - 28"	miscellaneous fill material, clay matrix, gravels, concrete chunks, few fine roots
28 - 48"	dark gray clay

Recommend: Cross-rip to 30"

Pit 10: Streamside, 7' west of TOB, 104' N of Pit 12

0 - 5"	topsoil clay fill materials
5 - 36"	fine sandy clay, common fine and coarse roots, highly mottled
36 - 48"	dark gray clay, few coarse roots

Recommend: Cross-rip to 38"

Pit 11: Streamside, 22' E of ditch, 104' N of Pit 12, in haul road, barn manure?

0 - 5"	clay fill materials, compacted
5 - 25"	fine sandy clay, common coarse roots
25 - 48"	dark gray clay, few coarse roots

Recommend: Cross-rip to 28"

Pit 12: Streamside, 14' W of TOB, 104' S of Pit 11, at base of large alder
photo 16 shows roots

0 - 7"	compacted topsoil fill
7 - 17"	miscellaneous fill material including concrete, gravel, dark clay loam
17 - 30"	very find sandy clay, many fine to coarse roots
30 - 48"	dark gray clay, few fine roots

Recommend: Cross-rip to 32"

Pit: 13: Streamside, just W of entrance road descent, 93' S of Pit 12, photos 17,18 show dark gray clay

0 - 8"	compacted topsoil fill
8 - 19"	fine sandy clay
19 - 31"	dark gray clay
31 - 48"	very dark gray clay 7.5YR 4/0

Recommend: rip to below 20"

Pit 14: Parkside, 15' E of secondary channel, 53' N of S end of walkway

0 - 10"	compacted topsoil fill materials
10 - 12"	fine sandy clay, abrupt boundary
12 - 18"	light gray clay with fine sand component
18 - 21"	fine sandy clay, many soft iron masses and root pore linings
21 - 48"	dark gray clay

Recommend: Cross-rip to 24"

Pit 15: Parkside, on edge of irrigation wetted soil, 29' E of walkway, 50' N of Pit 14

0 - 14"	topsoil back fill, top 8" highly compacted
14 - 16"	fine sandy clay
16 - 48"	dark gray clay

Recommend: Cross-rip to 18"

Pit 16: Parkside, 17' E of walkway, 161' N of Pit 15

0 - 17"	topsoil backfill
17 - 20"	fine sandy clay
20 - 48"	dark gray clay

Recommend: Cross-rip to 24"

Pit 17: Parkside, 29' E of walkway, 100' N of Pit 16

0 - 12"	topsoil fill compacted
12 - 20"	fine sand, common roots
20 - 22"	very dark gray clay
22 - 48"	dark gray clay, common fine roots

Recommend: Cross-rip to 22"

Pit 18: Parkside, 26' E of walkway, 126' S of Pit 19

0 - 10"	compacted topsoil fill
10 - 19"	fine sandy clay, abrupt boundary
19 - 22"	very dark gray clay (organic staining), mottled, many pore linings
22 - 48"	dark gray clay, many mottles and pore linings (38"-48" very moist)

Recommend: Cross-rip to 22"

Pit 19: Parkside, 34' E of walkway, 84' S of Pit 20

0 - 14"	compacted topsoil fill materials
14 - 32"	fine sandy clay with clay inclusions
32 - 35"	dark gray clay with black organic staining
35 - 54"	dark gray clay with many common iron masses

Recommend: Cross-rip to 32"

Note: Pit 19 was excavated to approximately 13', through heavy dark clay layer (5' thick) to gravels bearing water. Water rushed into hole, filling to within 2' of surface within an hour of breaching aquifer.

Pit 20: 13' E of walkway, 73' S of Pit 21, in incline up to walkway

0 - 30"	miscellaneous compacted fill materials
30 - 47"	fine sand, grading to fine sandy clay (wet)

Recommend: Cross-rip to 32"

Pit 21: Parkside, 20' E of walkway, 68' S of southern wing wall of storm drain outfall, in incline to walkway

0 - 54"	very compacted topsoil fill materials (with rubber, charcoal, metal); dry; roots to 22"

Recommend: Cross-rip to 36"

Pit 22: 35' E of walkway, 53' N of splash pool of storm drain outfall

0 - 15"	compacted topsoil fill with large roots and miscellaneous debris
15 - 40"	fine sand grading to fine sandy clay with dark iron masses
40 - 54"	dark gray clay (black organic horizon in upper 2")

Recommend: Cross-rip to 20"

Pit 23: Parkside, 25' E of walkway, 110' N of Pit 22, near base of large cottonwoods

0 - 5"	compacted topsoil fill materials
5 - 26"	fine sand grading to fine sandy clay, common fine to coarse roots
26 - 54"	dark gray clay with many iron masses, few coarse roots

Recommend: Cross-rip to 30", outside dripline of trees

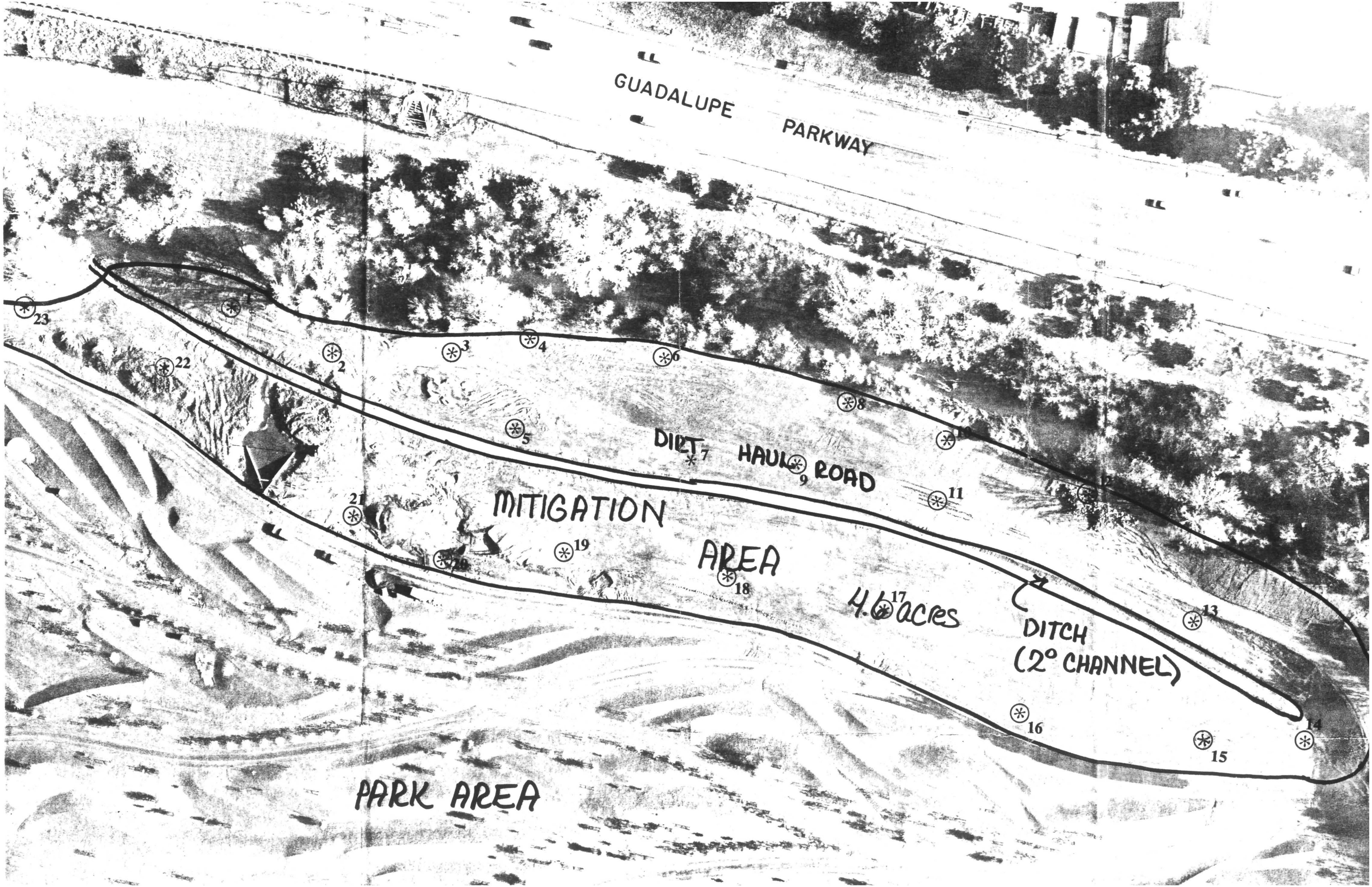
Note: No water or significant gravels within 16' of surface at this pit location.

DEPTH TO GROUNDWATER

Depth to groundwater was determined at selected pits while the pits were open for soil examinations. Not all pits were opened to groundwater; the following list describes he results of excavations in those examined. Earlier portions of this report have dealt with these results and the groundwater conditions of the site.

In this chart, the depth to groundwater is noted, the height (given as distance from surface) the rising water reached during the course of the examinations (which lasted a couple of hours) is noted, and pertinent comments are made. Free water found in the excavations was associated with gravels found below a thick black clay or sand layer which constrained the groundwater and when breached allowed a fast groundwater rise into excavated pit.

Pit #	Depth to Groundwater	Height of Groundwater Rise	Comments
1	10'	to 60"	fill materials above black clay; water rose slowly in pit
2	11'	to 60"	water rose slowly in pit
8	13'	to 48"	water rose rapidly in pit; final height was 2 feet > than Guadalupe River water surface
10	12'	to 90"	water rose slowly
15	13'	to 52"	within one hour
17	13'	to 24"	within 30 minutes
19	13'	to 24"	within 30 minutes
23	?	N/A	pit excavated to 16' -- no groundwater encountered


GUADALUPE PARKWAY
DIRT HAUL ROAD
MITIGATION AREA
4.6 acres
DITCH (2° CHANNEL)
PARK AREA
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
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